OPPORTUNITY COST COMPONENT

The following methodology is approved for computing opportunity costs for an externally imposed environmental regulation based run-hour restriction on a generation unit. Examples would include a limit on emissions for the unit imposed by a regulatory agency or legislation or, a direct run hour restriction in the operating permit, or a heat input limitation defined by a regulatory decision or operating permit. Requests for recovery of opportunity costs using other methods, or not defined in the Operating Agreement of PJM Interconnection, L.L.C. should be submitted to the PJM MMU for approval per Manual 15 Section 8.

Opportunity costs are a distinct component of the cost-based offer. As is the case with any computation of the cost-based offer in Manual M-15, market participants may elect to enter their cost-based offer at a value less than the computed cost-based offer. However, they may not exceed the computed value.

Opportunity costs calculated with this method maywill change frequently as. Given that electricity and fuel futures maycan change daily, the opportunity costs computed can likewise change daily. Generation owners who include opportunity costs in their cost-based offers must recalculate their opportunity cost no less frequently than once per week.

Web Portal:

Unit participants will submit their input data for the Monitoring Analytics' opportunity cost calculator through a web portal. That information will be stored in a database, and once a day, it will be processed by a SAS program in order to determine unit-specific opportunity costs. Those calculations for opportunity cost can be explained in nine steps.

STEP 1:
CREATE THREE SETS OF MONTHLY LMP FORECASTS AT THE GENERATION BUS

CREATE MONTHLY LMP FORECAST AT THE GENERATION BUS

Inputs to Step 1:
Three years of historical hourly real-time LMPs at the generation bus
Three years of historical hourly real-time PJM Western Hub LMPs
Platts-ICE Forward Curve for "PJM west" for the recent trading day

Inputs required for STEP 1:
Platts-ICE Forward Curve for "PJM west" for the recent trading day
Three years of historical hourly real-time LMPs at the generation bus
Three years of historical hourly real-time PJM Western Hub LMPs

Platts-ICE Forward Curve for "PJM west" (PJM Western Hub) must be collected for this first step (http://www.platts.com/). These PJM Western Hub Forwards are multiplied by a historical basis adjustment ratio for delivery to the generator's bus creates to calculate monthly delivered bus prices. The three prior calendar year's historical data is used to make this calculation. For units without a 12-month run-hour restriction, use historical LMP data, beginning on today's date to the end of the year from the previous three calendar years. For example, when computing opportunity costs on July 1, 2009 for a unit without a rolling 12-month run-hour restriction, use historical LMP data from July 1st (2006, 2007 and 2008) to December 31st (2006, 2007, and 2008). For units with a rolling 12-month run-hour restriction, use historical LMP data from the previous three years, beginning on the date calculated three years prior, ending on the previous day. For example, when computing opportunity costs on July 1, 2009 for a unit with a rolling 12-month run-hour restriction, use historical LMP data from July 1st (2006, 2007 and 2008) to June 30th (2007, 2008, and 2009). ~~For example, when computing opportunity costs in 2009, use historical LMP data from 2006, 2007 and 2008.~~ Begin by taking the hourly bus prices for the three prior ~~calendar~~ years at the generator's bus, and for every hour, divide that hour's price by the corresponding price at PJM Western Hub.

$$\mathrm{HourlyBasisRatio}_{\mathrm{y,m,d,h}}^{\mathrm{base\ year}} = \frac{\mathrm{BUSLMP}_{\mathrm{y,m,d,h}}^{\mathrm{baseyear}}}{\mathrm{PJMWHLMP}_{\mathrm{y,m,d,h}}^{\mathrm{baseyear}}}$$

Example 1.1: Three hourly bus ratios values for one hour of the year:

$$HourlyBasisRatio_{June\ 3,2006\ H11} = \frac{BUSLMP_{June\ 3,2006\ H11}}{PJMWHLMP_{June\ 3,2006\ H11}}$$

$$HourlyBasisRatio_{June\ 3,2007\ H11} = \frac{BUSLMP_{June\ 3,2007\ H11}}{PJMWHLMP_{June\ 3,2007\cancel{6}\ H11}}$$

$$HourlyBasisRatio_{June\ 3,2008\ H11} = \frac{BUSLMP_{June\ 3,2008\ H11}}{PJMWHLMP_{June\ 3,2008\cancel{6}\ H11}}$$

Once the hourly basis ratios are calculated for every hour during the three year history, take the on-peak hours in a month, sum the ratios, and divide by the number of observations. ~~Similarly~~In addition, for every month, sum the off-peak hourly basis ratios, and then divide by the number of off-peak hours within that month.

$$\mathrm{MonthlyPeakBasisRatio}_{\mathrm{y,m}}^{\mathrm{peak}} = \frac{\sum_{\mathrm{n=1}}^{\mathrm{N}}\left(\mathrm{HourlyBasisRatios}_{\mathrm{y,m,d,h}}^{\mathrm{peak}}\right)}{\sum \mathrm{N}_{\mathrm{y,m}}^{\mathrm{peak}}}$$

Example 1.2: Monthly Peak Basis for the three historical periods:

$$MonthlyPeakBasisRatio_{June\ 2006}^{\cancel{on}ONpeak} = \frac{\sum_{n=1}^{N}(Hourly\ Basis\ Ratios\ of\ ON\cancel{on}peak\ hours\ in\ June\ 2006)}{Number\ of\ \cancel{on}ONpeak\ hours\ in\ June\ 2006}$$

$$MonthlyPeakBasisRatio_{June\ 2007}^{\cancel{on}ONpeak} = \frac{\sum_{n=1}^{N}(Hourly\ Basis\ Ratios\ of\ \cancel{on}ONpeak\ hours\ in\ June\ 2007)}{Number\ of\ \cancel{on}ONpeak\ hours\ in\ June\ 2007}$$

$$MonthlyPeakBasisRatio_{June\ 2008}^{onONpeak} = \frac{\sum_{n=1}^{N}(Hourly\ Basis\ Ratios\ of\ onONpeak\ hours\ in\ June\ 2008)}{Number\ of\ onONpeak\ hours\ in\ June\ 2008}$$

These are the ratios that adjust PJM Western Hub forward prices monthly on-peak and off-peak to be delivered to the generator's bus. Multiply these ratios against by the PJM Western hub forwards to create calculate forecasted monthly bus prices, on-peak and off-peak.

$$\text{Forecasted Monthly Bus Price}_{fy,m}^{peak} = \left[(\text{PJMWestern Hub}_{fy,m}^{peak}) * (\text{MonthlyPeakBasisRatio}_{fy,m}^{peak})\right]$$

Example 1.3: Forecasted monthly bus prices for three historical periods:

$$Forecasted\ Monthly\ Bus\ Price_{June\ 201009}^{OFFpeak\ base2006} = \left[(PJMWH_{for\ delivery\ June\ 201009}^{OFFpeak}) * (MonthlyPeakBasisRatio_{June\ 201009}^{OFFpeak\ 2006})\right]$$

$$Forecasted\ Monthly\ Bus\ Price_{June\ 201009}^{OFFpeak\ base2007} = \left[(PJMWH_{for\ delivery\ June\ 201009}^{OFFpeak}) * (MonthlyPeakBasisRatio_{June\ 201009}^{OFFpeak\ 2007})\right]$$

$$Forecasted\ Monthly\ Bus\ Price_{June\ 201009}^{OFFpeak\ base2008} = \left[(PJMWH_{for\ delivery\ June\ 201009}^{OFFpeak}) * (MonthlyPeakBasisRatio_{June\ 201009}^{OFFpeak\ 2008})\right]$$

Outputss from STEP Step 1:
Three on-peak and off-peak monthly BUS LMP forecasts per month remaining in the compliance yearperiod.

STEP 2: CREATE THREE SETS OF SCALARS TO ADD HOURLY VARIABILITY TO THE MONTHLY FORECASTS:

STEP 2: Create scalars to add hourly volatility to the forecast
Inputs to Step 2:
Three years historical hourly real-time LMPs at the generation bus
Inputs for STEP 2:
Three years historical hourly real-time LMP prices at the generation bus

Step 2 will develop a volatilityvariability scalar. This scalar will later be multiplied by the *monthly BUS LMP* against the forecast calculated in step 1 to ultimately forecast a future hourly LMP.

First, ~~compute~~ calculate the average on-peak and off-peak price at the unit's bus for each remaining month in the compliance period.

$$MonthlyAverageOnONPeakLmp = \sum_{first\ ONonpeak\ hour\ of\ the\ month}^{last\ ONonpeak\ hour\ of\ the\ month} (HourlyONnpeakLMP) \Big/ numberofOnNpeakhours$$

$$MonthlyAverageOffFFPeakLmp = \sum_{first\ OFFoffpeak\ hour\ of\ the\ month}^{last\ OFFoffpeak\ hour\ of\ the\ month} (HourlyOffFFpeakLMP) \Big/ numberofOffOFFpeakhours$$

Next, calculate an hourly variability ratio for each hour by taking ~~Next, for every hour, take~~ the hourly bus LMP divided by the monthly average on-peak or off-peak bus LMP ~~computed~~ calculated above. If the hour is an on-peak hour, divide by the average on-peak LMP ~~price~~ for the month. If the hour is off-peak, divide that hour by the average ~~monthly~~ off-peak ~~average price~~LMP for the ~~corresponding~~ month.

$$\text{HourlyVolatilityVariabilityRatio}_{y,m,d,h}^{\text{base year}} = \frac{\text{BUSLMP}_{y,m,d,h}^{\text{peak}}}{\dfrac{\sum_{n=1}^{N_{y,m}^{\text{peak}}} \left(\text{BUSLMP}_{y,m}^{\text{peak}}\right)}{N_{y,m}^{\text{peak}}}}$$

Example 2.1: Creating one hour's ~~volatility~~variability ratio for the each of the three historical base years:

$$HourlyVolatilityVariabilityRatio_{June3,2006\ H243}^{base2006} = \frac{BUSLMP_{June\ 3,2006\ H243}}{Average\ OffOFFpeak\ June\ 2006\ BUSLMP}$$

$$HourlyVariabilityVolatilityRatio_{June3,2007\ H243}^{base2007} = \frac{BUSLMP_{June\ 3,2007\ H243}}{Average\ OFFOffpeak\ June\ 2007\ BUSLMP}$$

$$HourlyVariabilityVolatilityRatio_{June3,2008\ H243}^{base2008} = \frac{BUSLMP_{June\ 3,2008\ H243}}{Average\ OffFFpeak\ June\ 2008\ BUSLMP}$$

Outputs from ~~STEP~~ Step 2:
Three ratio values per hour for each of the historical years used for ~~volatility~~variability

STEP 3: CREATE THREE SETS OF HOURLY FORECASTED LMP ~~BUS~~ VALUES

Inputs to Step~~TEP~~ 3:
Output from S~~TEP~~tep 1: On-peak/off-peak monthly bus LMP Forecasts
Output from S~~TEP~~tep 2: Hourly ~~volatility~~variability scalars

-Step 3 creates three hourly forecasts from the volatilityvariability scalars developed in step 2 and the monthly bus LMP forecasts prices developed in Step 1. Multiply the three hourly volatilityvariability ratios scalars developed in step 2 by the corresponding forecasted monthly bus price calculated in step 1.

$$\text{ForecastedBUSLMP}^{\text{peak}}_{\text{y,m,d,h}} = \text{Hourly}\text{Volatility}\text{Variability}\text{Ratio}_{\text{y,m,d,h}} * \text{ForecastedMonthlyBusPrice}^{\text{peak}}_{\text{fy,m}}$$

Example 3.1: Forecasted bus LMPs for one hour for each of the three historical base years:
Assume that it is April 5, 2009. To create the set of three forecasted prices for each hour of June 3, 2009:

$$ForecastedBUSLMP^{baseyear2006}_{June\ 3,2009\ H00} = HourlyVolatilityVariabilityRatio_{June\ 3,2006\ H00} * ForecastedMonthlyBusPrice^{offOFFpeak}_{June\ 2009}$$

$$ForecastedBUSLMP^{baseyear2007}_{June\ 3,2009\ H00} = HourlyVariabilityVolatilityRatio_{June\ 3,2007\ H00} * ForecastedMonthlyBusPrice^{offOFFpeak}_{June\ 2009}$$

$$ForecastedBUSLMP^{baseyear2008}_{June\ 3,2009\ H00} = HourlyVariabilityVolatilityRatio_{June\ 3,2008\ H00} * ForecastedMonthlyBusPrice^{offOFFpeak}_{June\ 2009}$$

Outputss from STEP Step 3:
Three hourly bus LMP forecasts for each hour per hour remaining in the compliance yearperiod

STEP 4: CREATE THREE SETS OF DAILY FUEL SCALARS

STEP 4: Create a daily fuel volatility scalar
Inputs to Step 4:
Three years historical delivered daily fuel prices at the generator bus ($/mmBtu)
Inputs to STEP 4:
Three years historical delivered daily fuel prices at the generator bus ($/mmBtu)

Step 4 creates a daily fuel variability scalar using historical daily delivered fuel prices from the previous three calendar years. Take each daily delivered fuel price and divide it by the monthly average delivered fuel price to create a ratio for every day in the three year history. For units that have dual fuel types; the daily delivered fuel prices need to be multiplied by their respective weights and then added together:
Step 4 creates a daily fuel volatilityvariability scalar using historic daily delivered fuel prices from the previous three calendar years. Take each daily bus-delivered fuel price and divide it by the monthly average bus delivered fuel price to create a ratio for every day in the three year history. For units that have dual fuel types; the daily bus-delivered fuel prices need to be multiplied by their respective weight and then added together:

:

Units with Single Fuel Type:

$$DailyFuel\text{~~Volatility~~}VariabilityRatio_{y,m,d} = \frac{DeliveredFuelPrice_{y,m,d}}{\frac{\left(\sum_{n=1}^{N_m}\left(DeliveredFuelPrice_{y,m,d=n}\right)\right)}{N_m}}$$

Where N_m is the number of days in month m.

Units with Dual Fuel Types:

$$DailyFuelVariabilityRatio_{y,m,d} = \frac{(DeliveredFuelPriceFuelTypeA_{y,m,d} * WeightFuelTypeA) + (DeliveredFuelPriceFuelTypeB_{y,m,d} * WeightFuelTypeB)}{\frac{\left(\sum_{n=1}^{N_m}\left((DeliveredFuelPriceFuelTypeA_{y,m} * WeightFuelTypeA) + (DeliveredFuelPriceFuelTypeB_{y,m} * WeightFuelTypeB)\right)\right)}{N_m}}$$

Example 4.1: Three daily fuel ~~volatility~~variability scalar~~s~~ values developed for June 3, 2009 for a unit with a single fuel type:

$$DailyFuelV\text{~~olatility~~}ariabilityRatio_{June,3,2006} = \frac{DeliveredFuelPrice_{June\ 3,2006}}{Average\ June\ 2006\ DeliveredFuelPrice}$$

$$DailyFuelVariability\text{~~Volatility~~}Ratio_{June,3,2007} = \frac{DeliveredFuelPrice_{June\ 3,2007}}{Average\ June\ 2007\ DeliveredFuelPrice}$$

$$DailyFuelVariability\text{~~Volatility~~}Ratio_{June,3,2008} = \frac{DeliveredFuelPrice_{June\ 3,2008}}{Average\ June\ 2008\ DeliveredFuelPrice}$$

Outputs from Step 4:
Three historical daily fuel scalars for each day remaining in the compliance ~~year~~period

~~Output from STEP 4: Three years of historic daily scalars for fuel volatility~~

STEP 5: CREATE THREE SETS OF DAILY DELIVERED FUEL FORECASTS

~~STEP 5: Create 3 daily delivered fuel forecast~~
Inputs to Step 5:
Output from Step 4: Three years historical daily fuel scalars for each day remaining in the compliance ~~year~~period
Platts ~~F~~forward curve for ~~F~~fuel from the most recent trading day, for delivery in the compliance period ($/mmBtu) with a daily delivery charge adjustment
~~Inputs for STEP 5:~~
~~Platts Forward curve for Fuel from the most recent trading day, for delivery in the compliance period ($/mmBtu)~~
~~Output from STEP 4: Three years historic daily scalars for fuel volatility~~

Step 5 takes fuel futures forwards based on a unit's fuel policy (as approved by the MMU) and the daily delivered fuel scalars from step 4 and multiplies them together to create calculate a fuel forecast. The selected fuel forward price should be from the most recent trading day, for delivery in the compliance period. Once determined, a fuel forward index must be used for the duration of the calendar yearcompliance period. For units that have multiple fuel types; the daily delivered fuel scalar needs to bwill be multiplied by the fuel forward price and their respective weights per fuel type and added together. For units with some or all of their fuel coming from monthly contracts, the daily delivered fuel term will properly weight the monthly contract price and the daily delivered fuel forecast price for each day in a given month:estimated spot market price for each day in a given month:
that corresponds on an average monthly basis to the fuel futures, yet maintains historical volatility.

Units with Single Fuel Type:

$$Daily\ DeliveredFuel_{fy,m,d} = DailyFuelVariabilityRatio_{y,m,d} * (WeightSpot_m * FuelForward_{fy,m} + WeightContract_m * ContractPrice_m)$$

Units with Dueal Fuel Types:

$$DailyDeliveredFuel_{fy,m,d} = DailyFuelVariabilityRatio_{y,m,d} * \big(WeightSpot_m * \big(FuelForwardFuelTypeA_{fy,m} * WeightFuelTypeA + FuelForwardFuelTypeB_{fy,m} * WeightFuelTypeB\big) + WeightContract_m * ContractPrice_m\big)$$

$$Daily\ DeliveredFuel_{fy,m,d} = DailyFuelVolatilityRatio_{y,m,d} * FuelForward_{fy,m}$$

Example 5.1: Create three daily delivered fuel forecasts from the volatilitiesvariabilityies of three historic years:

$$DailyDeliveredFuelForecast_{June\ 3,2009}^{baseyear2006} = DailyFuel\mathit{Volatility}\mathit{Variability}Ratio_{June\ 3,2006} * FuelForward_{June\ 201009}$$

$$DailyDeliveredFuelForecast_{June\ 3,2009}^{baseyear2007} = DailyFuel\mathit{Variability}\mathit{Volatility}Ratio_{June\ 3,2007} * FuelForward_{June\ 201009}$$

$$DailyDeliveredFuelForecast_{June\ 3,2009}^{baseyear2008} = DailyFuel\mathit{Variability}\mathit{Volatility}Ratio_{June\ 3,2008} * FuelForward_{June\ 201009}$$

Outputs s from STEPtep 5:
Daily generator bus delivered fuel forecast

STEP 6: CREATE THREE SETS OF GENERATING UNITS DISPATCH COSTS

Step 6: create generating units dispatch cost for each of the three forecasts
Inputs to Step 6:

Output from Step 5: Daily ~~generator-bus~~ delivered fuel forecast ~~output from Step 5~~
Average Unit Heat Rate for the May-September period and October-April period of the previous available year
Unit SO2, CO2, and NOx Emission Rates
Futures prices for SO2, CO2 and NOx from Evolution Markets
VOM/Maintenance Adder as defined in M-15
~~*Inputs for STEP 6:*~~
~~*Average Unit Heat rate for the May-September period and October-April period of the previous available year*~~
~~*Fuel Prices output from Step 5*~~
~~*Unit SO2, CO2, and NOx Emission Rates*~~
~~*Futures prices for SO2, CO2 and NOx from Evolution Markets*~~
~~*Maintenance Adder as defined in M-15*~~

In step 6, take the unit characteristics, future emission allowance prices, the three daily fuel forecasts and create a daily unit dispatch cost for the three forecasts using the appropriate heat rate for the forecast day. Either the FMU adder or the 10% scaling factor may be used but not both. For each day in the three fuel forecasts, a unit dispatch cost is calculated as follows:

$$\mathrm{UnitDispatchCost}_{\mathrm{fy,m,d}}^{\mathrm{base\ year}} = \Big\{\Big[UnitHeatRate\left({}^{mmbtu}/_{mwh}\right) * DailyDeliveredFuelForecast(\$/mmbtu)_{fy,m,d}^{base\ year}\Big] + \Big[UnitHeatRate\ (mmbtu/mwh) * UnitNOxEmissionRate(lbs/mmbtu) * Cost\ of\ NOx\ \left({}^{\$}/_{lb}\right)\Big] + \Big[UnitHeatRate\ (mmbtu/mwh) * UnitSO_2EmissionRate(lbs/mmbtu) * Cost\ of\ SO_2\ \left({}^{\$}/_{lb}\right)\Big] + \Big[UnitHeatRate\ (mmbtu/mwh) * UnitCO_2EmissionRate(lbs/mmbtu) * Cost\ of\ CO_2\ \left({}^{\$}/_{lb}\right)\Big] + VOM + FMU\ (if\ applicable)\Big\} * \{Up\ to\ 1.1\ scalar\ factor\ (if\ applicable)\}$$

Example 6.1: Daily dispatch cost:

Unit heat rate=10.345 mmBtu/MWh
Unit NOx emission rate =0.328 lbs/mmBtu
Unit SO_2 emission rate=1.2 lbs/mmBtu
Unit CO_2 emission rate=117 lbs/mmBtu
DailyDeliveredFuelForecast=$3.01/mmBtu
Combined NOx Allowance cost=$1375/ton
SO_2 Allowance cost=$200/ton
CO_2 emission cost = $8/ton
VOM=$2.22/MWh
FMU=$0/MWh

$$UnitDispatchCost =$$

$$\left[\left(\frac{10.345mmbtu}{mwh}\right)*\left(\frac{\$3.01}{mmbtu}\right)\right]+$$
$$\left[\left(\frac{10.345mmbtu}{mwh}\right)*\left(\frac{0.328\ lbs}{mmbtu}\right)*\left(\frac{\$1375.00}{ton}\right)*\left(\frac{ton}{2000\ lbs}\right)\right]+$$
$$\left(\left[\left(\frac{10.345\ mmbtu}{mwh}\right)*\left(\frac{1.2\ lbs}{mmbtu}\right)*\left(\frac{\$200}{ton}\right)*\left(\frac{ton}{2000}lbs\right)\right]\right)+$$
$$\left[\left(\frac{10.345mmbtu}{mwh}\right)*\left(\frac{117lbs}{mmbtu}\right)*\left(\frac{\$8}{ton}\right)*\left(\frac{ton}{2000lbs}\right)\right]$$
$$+\left(\frac{\$2.22}{MWh}\right)+\left(\frac{\$0}{MWh}\right)$$

$$\text{UnitDispatchCost}_{\text{fy,m,d}}^{\text{base year}}=\left(\frac{\$31.16}{MWh}\right)+\left(\frac{\$2.34}{MWh}\right)+\left(\frac{\$1.25}{MWh}\right)+\left(\frac{\$4.85}{MWh}\right)+\left(\frac{\$2.22}{MWh}\right)=\$41.82/MWh$$

Outputss for from sStep 6:
Three forecasts for daily generator dispatch cost

STEP 7: CALCULATE THE RUN HOURS USED TO DATE FOR THE CURRENT CALENDAR OR ROLLING YEAR

Inputs to Step 7:
Generator real-time 5 minute bus MWs

Step 7 calculates the run hours of a generator based on the five minute intervals in the bus_lmp_5min table.used in the compliance period to date. Accumulate the running time from the start of the calendar or rolling year to midnight the previous day and round the total run time up to the nearest hour. For example, when computing opportunity costs for a calendar year on July 5, 2009, calculate total run hours from January 1, 2009 to July 4, 2009 11:59:59PM. Confirm the calculated run hour to the run hours input by the generator through the web portal.

Outputs from Step 7:
Generator Run Hours Used to Date

STEP 8: CALCULATE THE MARGIN FOR EACH HOUR IN THE THREE SETS OF HOURLY FORECASTS

Step 7: Calculate the margin for every hour in the 3 hourly forecasts
Inputs to Step 8:

Output from Step 3: Hourly Generator bus LMP forecast
Output from Step 6: Daily Generator Dispatch Cost
Output from Step 7: Generator Run Hours Used to Date
All future maintenance outage information
Unit-specific minimum run time parameter restriction
Unit-specific start up costs

Daily Generator Dispatch Cost from Step 6
Hourly Generator bus LMP forecast from Step 3
All future maintenance outage information
Unit-specific minimum run time parameter restriction
Unit-specific start up costs
Output from Step 7: Generator Run Hours Used to Date

Inputs for Step 7:
Daily Generator Dispatch Cost from Step 6
Hourly Generator bus LMP forecast from Step 3

Step 8 calculates the hourly margins the generator would receive by comparing the cost offer developed in step 6 against the hourly forecasted bus LMPs developed in step 3. To remove planned outages, for any future date that the unit will be offline, set the hours to unavailable for all three forecasts. For units with minimum run time restrictions, this step calculates total margins in blocks of adjacent hours, based on the sum of the margins of each block and the minimum run time parameter restriction of a unit. For units with start-up costs, the value of that start-up cost will be subtracted from the total margin of each block that contains a new start, but not from each subsequent incremental hour added to the block. Calculate the total margins for all blocks of hours in the three forecasts:

Step 7 8 calculates the hourly margin the generator would receive by comparing the cost offer developed in step 6 against the hourly forecasted bus LMPs developed in step 3. To remove planned outages, for any future date that the unit will be offline, set the hours to unavailable for all three forecasts. For units with minimum run time restrictions, this step calculates hourly margins in blocks of adjacent hours, based on the value of the marginal hours of each hour set and the minimum run time parameter restriction of a unit. Each block's value is calculated based on the forecasted LMP of a unit running multiple hours (based on a unit's parameter limited schedule) in succession. For units with start-up costs, the value of that start-up cost will be subtracted from the sum of each hourly margin of each hour block that contains a new start, but not from each subsequent incremental hour added to the block. Calculate the hourly margin for all block of hours in the three forecasts:

This methodology assumes no minimum run time, no ramping time restrictions and no startup cost. Calculate the hourly margin for every hour in the three forecasts:

$$HourlyUnitTotalMarginBlock_{block}^{base\ year} = \sum_{t=block}^{t=block+MinRunTime-1} ForecastedBUSLMP_{y(t),m(t),d(t),h(t)}^{base\ year} - UnitDispatchCost_{y(t),m(t),d(t)}^{baseyear}$$

Where $block$ ranges from 1 to $[totalNumberofHours - MinRunTime + 1]$ and $y(t), m(t), d(t), h(t)$ are the year, month, day and hour corresponding to the tth overall hour of the time period spanning from the date calculated to the end of the yearcompliance period to be forecasted.

The $totalNumberofHours$ variable represents the output from Step 7: Generator Run Hours used to date. This variable is the number of hours left in the yearcompliance period to be forecasted, and is based on the date calculated and whether or not the unit has a rolling 12 month run-hour restriction.

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If the HourlyUnitMargin < 0, then the HourlyUnitMargin = 0

Example 78.1: Computing hourly total margins with a minimum run time of one hour (i.e. no minimum run time restriction), using historical data from the past three calendar years

$$HourlyUnitTotalMarginBlock_{\text{block } 3679}^{base\ 2006} = \sum_{t=block}^{t=block+MinRunTime-1} ForecastedBUSLMP_{y(t),m(t),d(t),h(t)}^{base\ year} - UnitDispatchCost_{y(t),m(t),d(t)}^{baseyear} = \sum_{t=3679}^{t=3679+1-1} ForecastedBUSLMP_{y(t),m(t),d(t),h(t)}^{base\ 2006} - UnitDispatchCost_{y(t),m(t),d(t)}^{base\ 2006} = ForecastedBUSLMP_{y(3679),m(3679),d(3679),h(3679)}^{base\ 2006} - UnitDispatchCost_{y(3679),m(3679),d(3679)}^{base\ 2006} = ForecastedBUSLMP_{June\ 3,2009\ H07}^{base\ 2006} - UnitDispatchCost_{June\ 3,2009}^{base\ 2006} = \$53.23 - \$41.66 = \$11.57$$

- Similarly,

$$HourlyUnitTotalMarginBlock_{\text{block } \#3679}^{base\ 2007} = ForecastedBUSLMP_{June\ 3,2009\ H07}^{base\ 2007} - UnitDispatchCost_{June\ 3,2009}^{base\ 2006} = \$55.44 - \$57.88 = -\$2.44$$

$$HourlyUnitTotalMarginBlock_{\text{block } \#3679}^{base\ 2008} = ForecastedBUSLMP_{June\ 3,2009\ H07}^{base\ 2008} - UnitDispatchCost_{June\ 3,2009}^{base\ 2006} = \$49.78 - \$49.72 = \$0.06$$

At this point, the blocks of hours would be ranked according to the total value of their hourlytotal margins. . Finally, the start-up cost would be subtracted from each block that contains a new start, but not from each subsequent incremental hour added to the block.

Outputss from Step 8:
Three sets of ranked blocks of total margin forecasts including each hour in the compliance period, adjusted to include start-up costs for each block that contains a new start, with all future outage hours removed

Three sets of ranked blocks of hourly margin forecasts including each hour in the compliance period, adjusted to include start-up costs for each block that contains a new start, but not from each subsequent incremental hour added to the block, with all future outages hours taken out.

Output from step 7: Three hourly margin forecasts for each hour in the compliance period.

STEP 8: OUTAGES AND DATES PASSED.

Input to Step 8: All future maintenance outage information

For any future date that the unit will be offline, or for any date that has passed, set the margin equal to zero. Therefore, for each of the three forecasts, set all dates that the unit will be unavailable to have zero margins.

Output from step 8:
Three hourly margin forecasts for each hour in the compliance period with all future outages and previous days having margins equal to zero.

STEP 9: DETERMINE THE OPPORTUNITY COST ADDER

Step 9: Rank the three margin forecasts from largest to smallest value
Inputs to Step 9:
Output from Step 8: Three sets of ranked blocks of total margin forecasts
Three sets of ranked blocks of hourly margin forecasts including each hour in the compliance period, adjusted to include start-up costs

Input for Step 9: Three hourly margin forecasts from step 8 adjusted for outages and days passed

For each of the three years, the opportunity cost for that year will be the average total margin of the lowest value block added before the run hour limit was reached. The three opportunity costs will then be averaged to get the opportunity cost adder available to the generator. If the opportunity cost adder is less than 0, the opportunity cost adder will be set to 0. The opportunity cost adder which may be applied to each point on a unit's bid curve will be entered separately into eMkt by the participant.
For each of the three years, keep a running sum of the total number of hours included in each ranked block until the run hour limit is reached. The marginal value for that year will be the average hourly margin of the last block added before the run hour limit was reached. The three marginal values will then be averaged together to get the opportunity cost adder available to the generator. If the opportunity cost component is less than 0, the opportunity cost component will be set to 0. The opportunity cost component that may be applied to each point on a unit's bid curve will be entered separately into eMkt by the participant.
For each of the three years, rank the hourly margin forecasts from largest to smallest value. Number each by their rank order. The three numbers that correspond to the minimum run hour are averaged together to get the maximum opportunity cost available to the generator.

Example 9.1: A unit with 700 run hours left:

The average hourly margin value of the block which includes the 700th $\text{hour}_{\text{base2006}} = \$2.10/\text{MWh}$
The average hourly margin value of the block which includes the 700th $\text{hour}_{\text{base2007}}$
$= -\$2.14/\text{MWh}$ase2007loh
The average hourly marginvalue of the block which includes the 700th $\text{hour}_{\text{base2008}} = \$0.06/\text{MWh}$

700th hour opportunity cost componentadder = $\frac{\$2.10+(-\$2.14)+\$0.06}{3} = \$0.01/\text{MWh}$

Output from Step 9: the opportunity cost componentadder
FY=future year
BUSLMP=LMP at the unit's bus

~~**PJMWesternHub**=PJM Western Hub LMP~~
~~**Trading Day**=In respect of a particular futures market a day on which that Market open for trading~~
~~**Dm**=Delivery Month; Month the commodity contract is to deliver the commodity in the future.~~
~~**Base year**= one of the three historical years used to create volatility in the fuel and power forecasts~~
~~**On-peak**=Peak hours are from 7:00 AM to 11:00 PM (the hour ending 0800 to the hour ending 2300) prevailing local time. Peak days are Mondays through Fridays, excluding North American Electric Reliability Council (NERC) holidays.~~
~~**Off-peak**=Off-peak hours are from midnight to 7:00 AM (the hour ending 0100 to the hour ending 0700) and 11:00 PM to midnight (the hour ending 2400) Mondays through Fridays; also, all day Saturdays and Sundays (the hour ending 0100 to the hour ending 2400) and North American Electric Reliability Council holidays~~
~~FMU~~